A bargaining model of financial intermediation

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Abstract

This paper studies a financial market where investors have to search for investment projects. After identifying a profitable project, the investor bargains with the project owner about the financial contract. Alternatively, the investor may delegate search and bargaining to a financial intermediary. Delegation may be profitable since it reduces the project owner's share of the bargaining surplus. The investor, however, cannot monitor the intermediary's search behavior so that delegation may induce excessively risky investments. This restricts the parameter constellations under which the investors prefer intermediation to direct investment. Competition may not reduce the intermediaries' profits to zero because of incentive restrictions.

Keywords: Intermediation, Bargaining, Search; *JEL Classification No.:* C78, D83, G21

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1 Introduction

This paper develops a theory of financial intermediation based on the commitment effects of delegated search and bargaining. An intermediary is delegated the task of identifying investment projects and negotiating loan contracts. The cost of information gathering generates trade frictions that give rise to the function of intermediation. After identifying a project, the financier finds himself in a situation of partial bilateral monopoly with the entrepreneur because switching to another project is costly. Loan contracts are determined by a process of bilateral bargaining rather than by a competitive Walrasian market. In such an environment, delegated bargaining may increase the fund owners' share of the project return.

The investors may prefer intermediation to direct investment because the "use of a bargaining agent affects the power of commitment" (Schelling (1980), p. 29). The intermediary's repayment obligation to the depositors reduces the fraction of the bargaining surplus that the entrepreneurs are able to appropriate. Indeed, direct investment suffers from a tendency towards underinvestment because of a hold-up problem as described by Williamson (1975). Search for an investment opportunity is a relationship-specific investment. But, the search cost is sunk when the financier negotiates with an entrepreneur. The bargaining outcome does not compensate the investor for his search effort and, therefore, provides inefficient incentives to engage in search. This problem can, at least partially, be solved by ex-ante contracting and delegating search to an intermediary. As a result, intermediation may generate a Pareto-improvement so that all the market participants become better off.

The gains from intermediation are, however, limited by incentive restrictions. The fund owner is unable to monitor the intermediary's search and bargaining behavior. Also, the intermediary possesses no funds of his own so that the contract with the fund owner is a limited liability arrangement. As a consequence, the intermediary is less concerned about the risk of investment failure than the investor. He is inclined to select excessively risky investments. To avoid this, the investor has to make search for low-risk projects sufficiently attractive for the intermediary. As a consequence, he cannot appropriate the total gains from intermediation. Even though the intermediaries compete for funds, they may earn positive profits in equilibrium. This is consistent with perfect competition because the intermediary will search for relatively safe projects only if his expected payoff from searching is high enough. As a possible extreme, intermediation may become unprofitable for the fund owners. When the incentive problems associated with delegation are too severe, they prefer direct investment to intermediation. Then the investors themselves engage in search to deal directly with the entrepreneurs. The model endogenously determines the extent of the activity of the intermediaries.

Theories of financial intermediation are generally based on some cost advantage of the intermediaries. They either enjoy a comparative technological advantage to perform financial transactions or they are able to exploit economies of scale associated with these transactions. This paper completely abstracts from such technological considerations. The fund owners and the intermediaries are endowed with the same search technology. Also, the bargaining procedure is independent of whether the investor or the intermediary negotiates a loan contract with one of the entrepreneurs. This framework should not deny the potential role of scale economies for the activity of intermediation. Actually, the model can easily be extended to accommodate cost advantages of delegated search. But, we ignore such aspects to emphasize that intermediation may be viable even when it does not reduce transaction costs. In our model intermediation emerges because it affects the distribution of the gains from trade. It makes financing a project more attractive for the owners of liquid funds and helps to overcome an underinvestment problem. Furthermore, the abstraction from scale economies allows us to study competition among intermediaries without encountering the problem of equilibrium indeterminacy, which occurs with non-convex transaction technologies (see Matutes and Vives (1991) and Yanelle (1989)).

At least implicitly, already the early analysis of Gurley and Shaw (1960) employs scale economies to explain the activity of intermediation. In their view, financial intermediaries transform primary securities issued by firms into the more liquid financial securities desired by the fund owners. Intermediation is useful because indivisibilities in financial transactions limit the amount of diversification that can be achieved under direct finance. Diamond (1984) presents a different approach based on scale economies in reducing problems of asymmetric information. In his model, investment projects require funding from multiple investors. Therefore, delegating the task of supervising the project to a single intermediary is cheaper than monitoring by all the individual lenders. Pooling the funds of many lenders allows the intermediary to reduce the monitoring cost per project. At the same time, he can diversify his portfolio by financing a large number of projects. Diamond shows that these two effects may make intermediation more efficient to cope with the incentive problems of the borrower-lender relationship than direct finance.

Efficiency aspects are underlying also those explanations that view intermediaries as market makers. In these models the intermediaries offer bid and ask prices to attract traders from both sides of the market. Direct trade is either not possible or requires costly search for trading partners (see Stahl (1988) and Gehrig (1993)). The availability of intermediation thus creates a superior transactions technology. A similar advantage characterizes the intermediaries in Rubinstein and Wolinsky's (1987) bargaining and matching framework. They consider buyers, sellers and intermediaries who are randomly matched and then bargain over the terms of trade. The intermediaries enjoy a comparative advantage in making contacts and, thereby, speed up the process of exchange. Since each seller is randomly matched with a buyer or an intermediary, he cannot choose between direct and intermediated trade. In contrast with our model, therefore, both forms of trade coexist in equilibrium.

The following section of the paper describes a stylized model of a financial market. Section 3 analyses the investors' optimal search and bargaining strategy under direct investment. Delegated search and bargaining is introduced in section 4. Section 5 studies the equilibrium configurations that emerge for different parameter constellations.

Finally, section 6 concludes. All proofs are relegated to an appendix.

2 The Model

We consider a financial market with investors, entrepreneurs and intermediaries as the relevant economic agents. Only the investors possess liquid funds that can be used to finance investment projects. These projects are owned by the entrepreneurs. If a project is financed, it yields a random return. The riskiness of returns depends on the entrepreneur's type. The investor can allocate his funds to one of the projects in two ways: First, he may choose 'direct investment' by spending some effort in searching for a profitable project. After identifying a suitable investment, he bargains with the entrepreneur about the financial contract. The second option is 'intermediated investment', which amounts to delegating search and bargaining to one of the intermediaries. In this case, the investor contracts only with the intermediary; there is no direct contact between the investor and the entrepreneur who receives the funds. All agents are risk-neutral and seek to maximize their expected payoffs.

Each investor has some initial wealth $W > 0$. The riskless interest rate is normalized to zero and taken to be identical to the agents' common discount rate. Thus, the investor's payoff is simply W if he decides not to invest his wealth. Direct investment is costly because it requires search for an investment opportunity. The investor has to spend the effort cost $s > 0$ per period of search. With probability $0 < \mu < 1$ per period, search results in a random matching with one of the entrepreneurs. With the remaining probability $1 - \mu$ search is not successful and no match occurs. When the investor has found an entrepreneur, he is able to identify the risk of the entrepreneur's project. One possible interpretation of the matching process is that the entrepreneurs apply for a loan. A fraction $1 - \mu$ of the applications is 'junk' and not worth financing under any circumstances. The investor screens the applications to avoid bad loans and he has to pay s for performing a credit-worthiness test.

After classifying the risk category of a project, the investor may bargain with the project owner about the financial terms under which he will invest his funds. Alternatively, if he considers the project as too risky, he can quit and resume search. Of course, the option to quit is important also for the bargaining solution, which will be described below. The division of the available surplus will depend on this 'outside option' whenever quitting constitutes a credible threat.

There is a continuum of entrepreneurs. They have no initial wealth and rely on outside finance to undertake their projects. To focus on the search and bargaining aspects of intermediation, we assume that the amount W is sufficient to finance each of the projects. There is no efficiency gain in pooling the funds of several investors. This assumption is important to illustrate that intermediation may constitute an efficient allocation mechanism even in the absence of scale economies. Projects differ in their riskiness. There are two types of projects, indexed $i = A, B$. A fraction $0 < \alpha < 1$ of entrepreneurs owns a project of type A; the other entrepreneurs have $B-$type projects. When project i is undertaken, it generates the return $X > 0$ with probability $0 < p_i < 1$; with probability $1 - p_i$ it fails and yields zero return. We identify type A with a 'low-risk' project and type B with a 'high-risk' project by assuming

$$p_A > p_B. \tag{1}$$

In addition, we assume that the projects' expected profitability satisfies the following condition:

$$\underline{X} \equiv W/p_A < X < W/p_B \equiv \bar{X}. \tag{2}$$

Only projects of type A yield an expected return that exceeds the required investment W. When the investor identifies a type $B-$project, he will refuse to supply his funds since not investing at all would guarantee him a higher payoff. Direct investment will not occur unless the investor is prepared to search for an entrepreneur of type A. This reduces the number of possible equilibrium constellations. More importantly, it allows us to demonstrate that intermediation may result in excessively risky investments that would not be undertaken with direct finance.

The only difference between an investor and an intermediary is that the latter has no initial wealth. An intermediary becomes active only if he succeeds in attracting the funds of one of the investors. Since he is endowed with the same search technology as the investors, his effort cost of search is s per period. His probability of being matched with an entrepreneur of type A is $\mu\alpha$ in each period; the probability of finding a $B-$project is $\mu(1-\alpha)$. Also, when the intermediary bargains with one of the entrepreneurs, the equilibrium division of the surplus will follow the same rules as in the negotiations between an investor and an entrepreneur. Thus, the intermediaries do not have a technological comparative advantage over the investors.

There are, however, two important differences between direct and intermediated investment. First, in the case of intermediation the investor signs a contract with the intermediary before search takes place. This contract specifies the intermediary's repayment obligation to the investor. It has an important impact on the net surplus that is available in a match between the intermediary and an entrepreneur. Typically, intermediation will reduce the share of the project return that the entrepreneur is able to appropriate. Ex ante contracting between the investor and the intermediary generates a precommitment effect that is not present in the case of direct investment.

The second feature that distinguishes direct and intermediated investment is related to the investor's information. The investor is fully informed about the risk of his investment only in the case of direct investment. Since he is unable to monitor the intermediary's search and bargaining behavior, he remains uninformed about the project type selected by the intermediary. The intermediary can, however, credibly communicate the event of project failure. Appendix A proves that under these conditions delegated investment involves the contractual specification of some fixed payment of the intermediary to the investor after a successful investment. This form of contract is optimal even when the contractual agreement between the intermediary and the entrepreneur is public information.

To complete the description of the model, we have to describe the solution of the bargaining problem that arises when the investor or the intermediary is matched with one of the entrepreneurs. Note that the bargaining proceeds under perfect information after the project risk has been identified. Our bargaining solution will employ the 'outside option principle', which can be derived from a non-cooperative model of the bargaining process. The outside options describe the bargainers' disagreement payoffs. The investor and the intermediary have the outside option to terminate the bargaining process and to search for another entrepreneur. We consider the entrepreneur's outside payoff as negligible, because his chance to find another investor is effectively zero.

The bargaining solution is described by the following three properties: (i) an agreement on financing the project is reached only if the expected gross return exceeds the investor's (or the intermediary's) outside option payoff; (ii) in the case of an agreement, each bargainer gets a half-share of the expected return unless this would assign the investor (or the intermediary) less than his outside option; (iii) the agreement assigns the investor (or the intermediary) his outside option payoff whenever this exceeds half of the expected return. This solution can be derived formally from a non-cooperative alternating offers game when the players' discount rates are approximately zero. In this game the two parties exchange proposals and the prospective financier may react to the entrepreneur's offers by breaking off negotiations (see Bester (1989), (1990)). Binmore, Shaked, and Sutton (1989) report some experimental evidence that the prediction of this model performs well in comparison with the conventional, cooperative Nash bargaining solution.

3 Direct Investment

To investigate the conditions under which intermediation occurs in equilibrium, we first determine the investor's payoff in the absence of intermediation. He will search and directly invest in a project only if this yields higher expected profit than saving his initial wealth W. Let V_I denote the investor's expected gross benefit from direct investment. Direct investment is profitable when $V_I > W$. It follows that this investment strategy requires the investor to continue searching until he finds an entrepreneur of type A. Since $p_B X < W$ by assumption (2), the net surplus in a match with a type $B-$entrepreneur, $p_B X - V_I$, cannot be positive. Since the investor cannot gain by bargaining, he has to quit upon identifying a high-risk project.

Only low-risk projects offer a positive bargaining surplus. In a match with an entrepreneur of type A, the two parties bargain about the entrepreneur's payment obligation R_A after successful completion of the project. Given an agreement, the investor's expected profit is $p_A R_A$. According to the bargaining solution outlined in the foregoing Section, the investor gets half of the expected return $p_A X$ as long as this does not induce him to quit. If $0.5 p_A X > V_I$, quitting is not a credible option and the two parties find themselves in a situation of bilateral monopoly. In this case, they share the expected investment return equally. If $0.5 p_A X < V_I$, however, the investor's payoff from investing has to match his outside option, because otherwise he would quit. The bargaining agreement is, therefore, given by

$$p_A R_A = \max[0.5 p_A X,\, V_I]. \tag{3}$$

When searching for an investment opportunity, the investor rationally anticipates that a match with an $A-$type entrepreneur will result in the agreement described by (3). This allows him to calculate his expected payoff from direct investment. At the beginning of each period, he expects to find an $A-$project with probability $\mu\alpha$. With probability $1 - \mu\alpha$ he does not find such a project and has to continue his search. Accordingly, his expected payoff V_I equals

$$V_I = (1 - \alpha\mu) V_I + \alpha\mu \max[0.5 p_A X,\, V_I] - s. \tag{4}$$

To state the parameter constellations under which the investor gains from direct investment, we define the function

$$\varphi_1(X) \equiv \alpha\mu[0.5 p_A X - W]. \tag{5}$$

Proposition 1: *The investor's payoff from direct investment is* $V_I = [\alpha\mu 0.5 p_A X - s]/[\alpha\mu]$. *He prefers direct investment to saving his wealth if* $s < \varphi_1(X)$.

It turns out that the investor cannot use the threat of not investing when he bargains with an entrepreneur of type A. As $0.5p_A X > V_I$, his outside option remains ineffective. The intuition for this observation is simply that the investor cannot improve his situation by breaking off negotiations. When he finds another profitable project, he is again in the same bargaining situation as before, after having wasted resources on search.

Direct investment is unattractive whenever $0.5p_A \leq p_B$. Indeed, assumption (2) implies $\varphi_1(X) > 0$ if and only if $0.5p_A > p_B$. Moreover, $\varphi_1(\underline{X}) < 0$. Thus the investor may gain by searching for an investment only if $0.5p_A > p_B$. In addition, his search cost s has to be sufficiently small and the return X has to be high enough.

To develop some intuition for the gains from intermediation, it is helpful to compare the investor's decision rule with the socially efficient decision. By assumption (2) only low-risk projects generate a positive social surplus, namely $p_A X - W$. The expected number of periods until such a project is discovered equals $1 + (1 - \alpha\mu) + (1 - \alpha\mu)^2 + ... = 1/(\alpha\mu)$. Accordingly, the social surplus from searching for a low-risk project equals $p_A X - W - s/(\alpha\mu)$ and so investment is socially profitable whenever $s < \alpha\mu[p_A X - W]$. A comparison with (5) reveals that the investor is less inclined to search than is socially optimal. There is some range of parameter constellations where search is not privately beneficial for the investor even though it creates a social benefit. Searching for a project is a specific investment in the sense of Williamson (1975). The division of surplus arising from bargaining provides too little incentive to select the efficient level of investment. Ex ante contracting between the investor and the intermediary can, at least partially, overcome this underinvestment problem. It creates a commitment effect that alters the allocation of the project return.

4 Delegated Bargaining

When the investor relies on intermediated investment, he transfers his funds to an intermediary. The intermediary then selects a project on the behalf of the investor. Since the latter cannot directly monitor the intermediary's behavior, he has to provide appropriate contractual incentives. Let V_M denote the intermediary's payoff from searching for a project. The intermediary will search only if V_M is non-negative. It is, therefore, not optimal to reward the intermediary by some up-front payment. Instead, he will be motivated to search by the expected financial gain from a successful investment. This gain is determined by the intermediary's contractual relations with the investor and the entrepreneur.

The investor delegates the investment decision under a contract that specifies the intermediary's repayment obligation $\bar{R}$ in the event of a successful investment. The contract cannot condition on the project's riskiness since the investor is unable to monitor the intermediary's investment decision. In Appendix A we show that this implies that a fixed repayment obligation $\bar{R}$ constitutes an optimal contract. This is so even when the financial arrangement between the intermediary and the entrepreneur is publicly observable. When the intermediary is matched with an entrepreneur of type i, he either finances the project or continues to search. A project is undertaken if the two parties agree on the payment R_i that the intermediary receives should the return X realize. Given R_i, the intermediary's expected gain from financing a project equals $p_i(R_i - \bar{R})$, because he has to transfer the amount $\bar{R}$ to the investor.

The available gross surplus in a match between the intermediary and an $i-$type entrepreneur depends on the initial contract $\bar{R}$; it equals $p_i(X-\bar{R})$. This surplus determines whether the project will be funded or not. As long as $V_M < p_i(X - \bar{R})$, there are gains from undertaking the project and so the intermediary will negotiate with entrepreneur i. The bargaining outcome obliges the entrepreneur to pay R_i if the investment is successful. The intermediary's expected payoff from the agreement is $p_i(R_i - \bar{R})$. Using the same bargaining solution as in equation (3), we get

$$p_i(R_i - \bar{R}) = \max[0.5p_i(X - \bar{R}),\, V_M]. \tag{6}$$

When $V_M > p_i(X - \bar{R})$, there cannot be a mutually beneficial agreement between the intermediary and entrepreneur i. In this case, the intermediary will quit because he is better off by resuming search than by investing. Actually, he is indifferent between funding a project and quitting if $V_M = p_i(X - \bar{R})$. As a tie-breaking rule, we assume that he quits in this situation.

The bargaining solution allows us to calculate the intermediary's payoff from searching V_M. His payoff in a match with an entrepreneur of type i equals $0.5p_i(X - \bar{R})$ as long as $V_M \leq 0.5p_i(X - \bar{R})$. Otherwise, he always gets V_M. Indeed, when $0.5p_i(X - \bar{R}) \leq V_M < p_i(X - \bar{R})$, the bargaining agreement matches his outside option payoff V_M. If $V_M \geq p_i(X - \bar{R})$, he gets V_M by quitting and continuing his search. Accordingly, the intermediary's expected payoff from signing a contract with the investor equals

$$V_M = (1-\mu)V_M + \mu\alpha \max[0.5p_A(X - \bar{R}),\, V_M] \tag{7}$$

$$+\mu(1-\alpha)\max[0.5p_B(X - \bar{R}),\, V_M] - s.$$

The solution $V_M(\bar{R})$ of this equation depends on the initial contract $\bar{R}$.

We denote the investor's expected payoff from intermediated investment by $U_I(\bar{R})$. The initial contract $\bar{R}$ affects this payoff in two ways. First, there is a direct effect because the investor receives $\bar{R}$ upon completion of a successful project. The second effect is related to the intermediary's search incentives. The likelihood of actually receiving $\bar{R}$ depends on the intermediary's selection of project risks.

Proposition 2: *The intermediary's payoff $V_M(\bar{R})$ is decreasing in $\bar{R}$. Moreover, $V_I(\bar{R}) < 0.5p_A(X - \bar{R})$ for all $\bar{R} \in [0, X]$. The investor's payoff from intermediated investment is $U_I(\bar{R}) = [\alpha p_A + (1-\alpha)p_B]\bar{R}$ if $0 \leq V_M(\bar{R}) < p_B(X - \bar{R})$, and $U_I(\bar{R}) = p_A\bar{R}$ if $0 \leq p_B(X - \bar{R}) \leq V_M(\bar{R})$.*

As a result, the intermediary will never quit a low-risk project. Of course, he may optimally quit a high-risk project to search for a low-risk project. The second part of the Proposition describes the intermediary's search behavior and its impact on the investor's payoff. In the first case, the intermediary funds the first project he finds, independently of its riskiness. Accordingly, the average probability of a successful investment is $\alpha p_A + (1-\alpha)p_B$. In the second case, he selects only low-risk projects, which succeed with probability p_A.

Interestingly, the investor cannot appropriate the entire gains from intermediation if he wants to avoid investment in high-risk projects. That is, $U_I(\bar{R}) = p_A\bar{R}$ implies $V_I(\bar{R}) > 0$. This follows from the last statement in the Proposition because $V_I(\bar{R}) \geq 0$ implies $\bar{R} < X$ so that $V_I(\bar{R}) \geq p_B(X - \bar{R}) > 0$. The intermediary is motivated to search for projects of type A only if he benefits from quitting a $B-$project.

The investor's payoff $U_I(\bar{R})$ is not necessarily increasing in $\bar{R}$. It can happen that an increase in $\bar{R}$ reduces $U_I(\bar{R})$. The reason is, of course, that such an increase may alter the intermediary's search behavior. Only relatively low values of $\bar{R}$ provide an incentive to search for low-risk investments. This observation is closely related to Stiglitz and Weiss (1981), who show that higher repayment obligations can increase the attractiveness of high-risk investment opportunities.

Intermediation reduces the low-risk entrepreneurs' expected gains from bargaining. By (6) and (3), their expected payoff is $0.5p_A(X - \bar{R})$ in a match with the intermediary, whereas they receive $0.5p_A X$ by negotiating directly with the investor. As a result of intermediation, the $A-$type entrepreneurs are left with a smaller share of the project return. Intermediation becomes attractive for the investor if he can appropriate a sufficient fraction of the remaining share.

5 Equilibrium Intermediation

Financial intermediation is viable if two conditions are fulfilled. First, the investor's expected payoff from intermediated investment must exceed the payoff that he can get on his own, either by direct investment or saving his wealth. Second, the intermediary must receive an expected payoff from searching which is at least zero. Intermediation is said to be profitable if there is an $0 \leq \bar{R} \leq X$ such that

$$U_I(\bar{R}) > \max[V_I, W] \quad \text{and} \quad V_M(\bar{R}) \geq 0. \tag{8}$$

Whenever this condition is satisfied, the market equilibrium will be characterized by intermediated investment. Of course, to determine how the investor and the intermediary divide the profits from delegated search, we have to be more specific about the interaction between these agents. We will assume that the intermediaries compete for the investors' funds. The number of potential intermediaries is sufficiently large so that some will not become active in equilibrium. In this situation, competition among the intermediaries will determine some value $\bar{R}^*$ that maximizes the investor's profit $U_I(\bar{R})$ subject to the intermediary's individual rationality constraint $V_M(\bar{R}) \geq 0$.

Perfect competition does not necessarily reduce the intermediaries' expected profit to zero. Incentive considerations play an important role in the determination of $\bar{R}^*$. There are two possible equilibrium candidates, $\bar{R}_0$ and $\bar{R}_A$, defined by

$$V_M(\bar{R}_0) = 0 \quad \text{and} \quad V_M(\bar{R}_A) = p_B(X - \bar{R}_A). \tag{9}$$

In the foregoing Section it was shown that $V_M(\bar{R}_A)$ must be positive which implies that $\bar{R}_0 > \bar{R}_A$. By Proposition 2, in an equilibrium with $\bar{R}^* = \bar{R}_0$ the intermediary will finance both types of projects. In contrast, $\bar{R}^* = \bar{R}_A$ will induce him to quit high-risk projects and to fund only low-risk investments.

Altogether, there are four possible equilibrium categories: (i) if intermediation is not profitable and $W \geq V_I$, the investor will simply save his wealth; (ii) if intermediation is not profitable and $V_I > W$, direct investment occurs; (iii) if intermediation is profitable

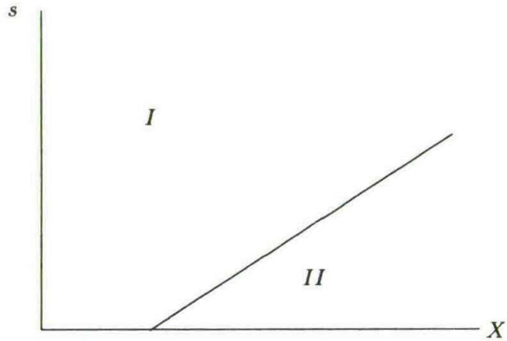

Figure 1: Equilibrium for $0.5p_A \leq p_B$

and $U_I(\bar{R}_0) \geq U_I(\bar{R}_A)$, intermediated investment takes place and $\bar{R}^* = \bar{R}_0$; (iv) if intermediation is profitable and $U_I(\bar{R}_A) > U_I(\bar{R}_0)$, there will be intermediation with $\bar{R}^* = \bar{R}_A$.

In what follows, we investigate which kind of equilibrium emerges under a given set of parameter constellations. We start by considering the case where the difference in project risks is relatively small so that $0.5p_A \leq p_B$. Define

$$\varphi_2(X) \equiv 0.5\mu[\alpha p_A X + (1-\alpha)p_B X - W]. \tag{10}$$

By (2), $\varphi_2(\underline{X}) < 0 < \varphi_2(\bar{X})$ and so $\varphi_2(X) > 0$ for X sufficiently large.

Proposition 3: *Let $0.5p_A \leq p_B$. Then the investor saves his wealth if $s \geq \varphi_2(X)$. If $s < \varphi_2(X)$, there is intermediated investment with $\bar{R}^* = \bar{R}_0$.*

Figure 1 illustrates how the equilibrium is related to the parameters s and $X \in (\underline{X}, \bar{X})$. The function $s = \varphi_2(X)$ defines the borderline between regions I and II. For parameters in region I the investor saves his wealth. In region II the equilibrium is characterized by delegated search; the intermediary earns zero expected profits and finances the first project he encounters.

In Section 3 it was shown that under the conditions of Proposition 3 the investor will always prefer saving over direct investment. In region II of Figure 1, therefore, intermediation generates a Pareto improvement. Both the investor and the entrepreneur, whose project is undertaken, are better off than in the absence of intermediation. A remarkable feature of the equilibrium is that in region II also inefficient project have a chance to be financed. These inefficiencies are caused by the incentive effects of intermediation. The investor accepts that with probability $1-\alpha$ his funds may be used to fund a high-risk project. Since the difference between project risks is relatively small, he finds this more attractive than enforcing search for low-risk investments through a contract $\bar{R}_A < \bar{R}_0$.

We now turn to the case $0.5p_A > p_B$. By Proposition 1, there is a range of parameter values of s and X where the investor is better off by direct investment than by saving his wealth. It turns out that for these parameter values the profitability of intermediation depends critically on the likelihood of finding a low-risk entrepreneur. We will first concentrate on situations where α is relatively high. To describe the market equilibrium for $\alpha \geq \bar{\alpha} \equiv (0.5p_A - p_B)/(1.5p_A - p_B) > 0$, we define

$$\varphi_3(X) \equiv \mu\alpha[0.5p_A X - p_B X - 0.5W + p_B W/p_A], \tag{11}$$

and

$$\varphi_4(X) \equiv \mu\alpha[0.5p_A X - p_B X \frac{p_A(1.5-0.5\alpha)-(1-\alpha)p_B}{p_A(1-\alpha)+2\alpha p_B}]. \tag{12}$$

Since $0.5p_A > p_B$, $\varphi_3(X)$ and $\varphi_4(X)$ are positive over the interval $(\underline{X}, \bar{X})$. Moreover, there is an $\hat{X} \in (\underline{X}, \bar{X})$ such that

$$\varphi_2(\hat{X}) = \varphi_3(\hat{X}) = \varphi_4(\hat{X}) \quad \text{and} \quad \varphi_2(X) > \varphi_3(X) > \varphi_4(X) \quad \text{for} \quad X > \hat{X}. \tag{13}$$

In Figure 2, the function $\varphi_3(\cdot)$ is depicted for $X \leq \hat{X}$; it represents the borderline between region I and III. The functions $\varphi_2(\cdot)$ and $\varphi_4(\cdot)$ are depicted for $X \geq \hat{X}$; they separate region II from regions I and III, respectively. The following result describes the properties of equilibrium in the three regions of Figure 2.

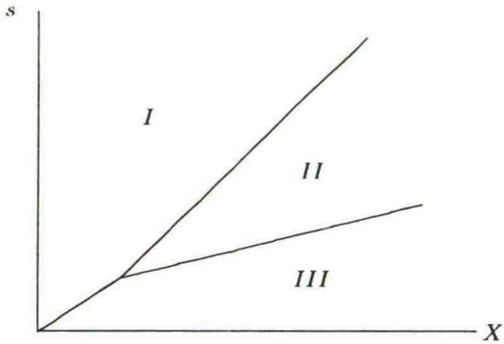

Figure 2: Equilibrium for $\alpha \geq \bar{\alpha} > 0$

Proposition 4: *Let* $\alpha \geq (0.5p_A - p_B)/(1.5p_A - p_B) > 0$. *Then the investor saves his wealth if* $s \geq \max[\varphi_2(X), \varphi_3(X)]$. *If* $\varphi_4(X) < s < \varphi_2(X)]$, *there is intermediated investment with* $\bar{R}^* = \bar{R}_0$. *If* $s < \min[\varphi_3(X), \varphi_4(X)]$, *there is intermediated investment with* $\bar{R}^* = \bar{R}_A$.

Again, direct investment does not emerge as a possible equilibrium. This is so because the riskiness of delegated investment is small for high values of α. Indeed, $\max[\varphi_2(X), \varphi_3(X)] \geq \varphi_1(X)$ as long as $\alpha > \bar{\alpha}$. This means that region I in Figure 2, where the investor saves his wealth, is a subset of the parameter constellations where saving occurs in the absence of intermediation. Intermediation, therefore, yields a Pareto improvement in some parts of regions II and III. Region III features a category of equilibrium that was not viable in Figure 1. Here delegated search avoids excessively risky investments and the active intermediaries earn positive profits. This is consistent with perfect competition among the intermediaries because any $\bar{R}$ below $\bar{R}_A$ would destroy their incentives to contract exclusively with low-risk entrepreneurs. Competition drives the intermediaries' payoff to zero only in region II. In fact, it is easily established that the difference $\bar{R}_0 - \bar{R}_A$ is increasing in the search cost s. From the investor's perspective $\bar{R}_A$ dominates $\bar{R}_0$ only if s is relatively small.

Finally, we consider the parameter constellation $\bar{\alpha} \equiv (0.5p_A - p_B)/(1.5p_A - p_B) >$

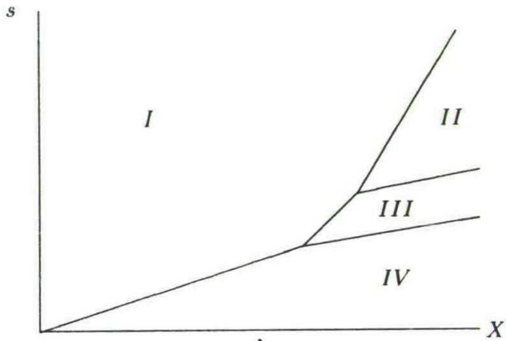

Figure 3: Equilibrium for $\bar{\alpha} > \alpha > 0$

$\alpha > 0$. Let

$$\varphi_5(X) \equiv \mu\alpha[0.5p_A X - p_B X \frac{p_A}{0.5p_A + p_B}]; \ \varphi_6(X) \equiv \mu\alpha[0.5p_A X - p_B X \frac{1-\alpha}{1-2\alpha}]. \quad (14)$$

Then $\varphi_6(X) > \varphi_5(X) > 0$ for all $X \in (\underline{X}, \bar{X})$ because $\alpha < \bar{\alpha}$. Moreover, there exist $\tilde{X}_1$ and $\tilde{X}_2$ with $\underline{X} < \tilde{X}_1 < \tilde{X}_2 < \bar{X}$ such that

$$\varphi_1(\tilde{X}_1) = \varphi_3(\tilde{X}_1) = \varphi_5(\tilde{X}_1) \quad \text{and} \quad \varphi_1(\tilde{X}_2) = \varphi_2(\tilde{X}_2) = \varphi_6(\tilde{X}_2). \quad (15)$$

In Figure 3, $\varphi_3(\cdot)$ represents the borderline between regions I and IV; the borderline between regions III and IV is determined by the function $\varphi_5(\cdot)$. The functions $\varphi_1(\cdot)$ and $\varphi_6(\cdot)$ separate region III from regions I and II, respectively. Finally, $\varphi_2(\cdot)$ constitutes the dividing line between I and II. The following statement characterizes the equilibrium category in regions I, II, III, and IV, respectively.

Proposition 5: *Let $\alpha < (0.5p_A - p_B)/(1.5p_A - p_B)$. Then the investor saves his wealth if $s \geq \max[\varphi_1(X), \varphi_2(X), \varphi_3(X)]$. If $\varphi_6(X) < s < \varphi_2(X)$, there is intermediated investment with $\bar{R}^* = \bar{R}_0$. Direct investment occurs if $\varphi_5(X) < s < \min[\varphi_1(X), \varphi_6(X)]$. Finally, if $s < \min[\varphi_3(X), \varphi_5(X)]$, there is intermediated investment with $\bar{R}^* = \bar{R}_A$.*

In contrast with the previous cases, there may now be a role for direct investment in equilibrium. For parameter values in region III of Figure 3, the investor makes the most profitable use of his wealth by searching for an $A-$type entrepreneur. Intermediated investment with $R^* = R_A$, which occurs in region IV, is an inferior option in region III. Since R_A is determined by incentive restrictions, the difference $V_I - p_A R_A$ increases with s and becomes positive for $s > \varphi_5(X)$. A similar argument explains why intermediation with $\bar{R}^* = \bar{R}_0$ is restricted to parameter values in region II. As α is relatively small, there is a high risk that the intermediary will select an inefficient project. The investor can profitably avoid this risk by direct investment if search is not too costly.

6 Conclusion

It has been shown that intermediation may emerge in financial markets even when it fails to reduce transaction costs. Intermediation creates commitment advantages that affect the distribution of the gains from trade. The fund owners will rely on intermediated investment when this allows them to appropriate a larger share of the investment return. The limits to the activity of the intermediaries are given by the negative incentive effects of delegated information gathering. The trade-off between the commitment and the incentive considerations endogenously determines the role of intermediation.

To illustrate this point, we have considered a highly stylized model of a financial market. In particular, we have abstracted from the presence of scale economies, which play an important role in other theories of financial intermediation. Our model, however, may be extended to take account of such efficiency aspects. For instance, intermediation will exhibit scale economies when the funds of a single investor do not exhaust the capacity of an investment project. Then there is a cost advantage to pooling the funds of several investors and delegating search to a single intermediary. The intermediary's search and bargaining strategy will depend also on the amount of funds that he has attracted. This creates a coordination problem among depositors and it is not no longer clear that competition among the intermediaries entails efficiency.

Appendix A:

In this appendix, we show that the optimal contract between the intermediary and the investor specifies a fixed payment obligation $\bar{R}$ for the intermediary. This is true even when the contract R_i between the intermediary and entrepreneur i is public information. Given that the project risk selected by the intermediary is not observable to outsiders, the most general contract between the investor and the intermediary is given by a function $\gamma(R_i)$. The interpretation is that the intermediary has to pay $0 \leq \gamma(R_i) \leq X$ to the investor when the project is successful.

Given a contract $\gamma(\cdot)$, the solution R_i of the bargaining game between entrepreneur i and the intermediary has to satisfy

$$p_i(R_i - \gamma(R_i)) = \max[0.5p_i(X - \gamma(R_i)),\, V_M]. \tag{16}$$

Assume that the solution R_i is unique.

Competition between the intermediaries will result either in some contract $\gamma_0(\cdot)$ or in some contract $\gamma_A(\cdot)$, with

$$V_M(\gamma_0) = 0 \quad \text{and} \quad V_M(\gamma_A) = p_B(X - \gamma_A(R_A)). \tag{17}$$

Under $\gamma_0(\cdot)$ the intermediary invests in the first project he finds; under $\gamma_A(\cdot)$ he searches for a low risk project. First, consider the case where the investor gets a higher payoff from $\gamma_0(\cdot)$ than from $\gamma_A(\cdot)$. In this case, the bargaining solution has to satisfy

$$R_A - \gamma_0(R_A) = 0.5(X - \gamma_0(R_A)), \quad R_B - \gamma_0(R_B) = 0.5(X - \gamma_0(R_B)). \tag{18}$$

This immediately implies $\gamma_0(R_A) = \gamma_0(R_B)$. Therefore, a simple non-contingent contract $\bar{R}_0$, with $\bar{R}_0 \equiv \gamma_0(R_A) = \gamma_0(R_B)$, generates the same payoffs as the contract $\gamma_0(\cdot)$. Next, consider the case where contract $\gamma_A(\cdot)$ is optimal for the investor. Obviously, in this case, the contract $\gamma_A(\cdot)$ is equivalent to a non-contingent contract $\bar{R}_A$ with $\bar{R}_A \equiv \gamma_A(R_A)$.

Appendix B:

Proof of Proposition 1: It is easily verified that $V_I \geq 0.5p_A X$ yields a contradiction to $s > 0$. Therefore, the unique solution of (4) is $V_I = [\alpha\mu 0.5 p_A X - s]/[\alpha\mu]$. The second statement follows from the fact that $V_I > W$ is identical to $s < \varphi_1(X)$. Q.E.D.

Proof of Proposition 2: It is easily verified that $V_M \geq 0.5p_A(X - \bar{R})$ yields a contradiction to $s > 0$. The r.h.s. of equation (7) is a continuous function $g(V_M, \bar{R})$ with $g(V_M', \bar{R}) > V_M'$ for V_M' small enough and $g(V_M'', \bar{R}) < V_M''$ for V_M'' large enough. Since $\Delta g/\Delta V_M \leq 1$, there is a unique solution $g(V_M, \bar{R}) = V_M$. Moreover, $V_M(\bar{R})$ is strictly decreasing in $\bar{R}$ because $g(V_M, \bar{R})$ is strictly decreasing in $\bar{R}$. The other statements follow simply from the intermediary's search behavior. Q.E.D.

Proof of Proposition 3: Since $0.5p_A \leq p_B$ implies $s \geq \varphi_1(X)$ there cannot be direct investment in equilibrium. The solution of equation (9) yields

$$\bar{R}_0 = \frac{\alpha p_A X + (1-\alpha)p_B X - 2s/\mu}{\alpha p_A + (1-\alpha)p_B}; \quad \bar{R}_A = \frac{0.5p_A X - p_B X - s/(\mu\alpha)}{0.5p_A - p_B}. \tag{19}$$

As $\bar{R}_A \leq X$ implies $0.5p_A > p_B$, there cannot be intermediated investment with $\bar{R}^* = \bar{R}_A$. Intermediated investment with $\bar{R}^* = \bar{R}_0$ occurs if $U_I(\bar{R}_0) = [\alpha p_A + (1-\alpha)p_B]\bar{R}_0 > W$. This condition is equivalent to $s < \varphi_2(X)$. Q.E.D.

Proof of Proposition 4: By definition of $\varphi_2(\cdot)$, one has $U_I(\bar{R}_0) > W$ if and only if $s < \varphi_2(X)$. Similarly, $U_I(\bar{R}_A) = p_A\bar{R}_A > W$ if and only if $s < \varphi_3(X)$. It is easily verified that $\alpha \geq (0.5p_A - p_B)/(1.5p_A - p_B)$ implies $\max[\varphi_2(X), \varphi_3(X)] \geq \varphi_1(X)$. Thus saving his wealth maximizes the investor's payoff if $s \geq \max[\varphi_2(X), \varphi_3(X)]$.

By definition of $\varphi_4(\cdot)$, one has $U_I(\bar{R}_A) > U_I(\bar{R}_0)$ if and only if $s < \varphi_4(X)$. Accordingly, $U_I(\bar{R}_A) > \max[U_I(\bar{R}_0), W]$ for $s < \min[\varphi_3(X), \varphi_4(X)]$. Moreover, $s < \varphi_4(X)$ and $\alpha \geq \bar{\alpha}$ implies $s < \varphi_5(X)$, where $\varphi_5(\cdot)$ is defined by (14). As $s < \varphi_5(X)$, is equivalent to $U_I(\bar{R}_A) > V_I$ this proves that intermediation with $\bar{R}_A$ is optimal for $s < \min[\varphi_3(X), \varphi_4(X)]$.

For $\varphi_4(X) < s < \varphi_2(X)$, it is the case that $U_I(\bar{R}_0) > \max[U_I(\bar{R}_A), W]$. Moreover, for $\alpha \geq 0.5$ and $s < \varphi_1(X)$ one has $s < \varphi_6(X)$, where $\varphi_6(\cdot)$ is defined by (14). As $s < \varphi_6(X)$ together with $\alpha > 0.5$ is equivalent to $U_I(\bar{R}_0) > V_I$, direct investment cannot be optimal for $\alpha \geq 0.5$. Similarly, for $\bar{\alpha} \leq \alpha < 0.5$, one has $\varphi_4(X) \geq \varphi_6(X)$. Therefore,

$s > \varphi_4(X)$ implies $s > \varphi_6(X)$. As $s > \varphi_6(X)$ together with $\bar{\alpha} \leq \alpha < 0.5$ is equivalent to $U_I(\bar{R}_0) > V_I$, this proves that intermediation with $\bar{R}_0$ is optimal for $\varphi_4(X) < s < \varphi_2(X)$. Q.E.D.

Proof of Proposition 5: As $s \geq \max[\varphi_1(X), \varphi_2(X), \varphi_3(X)]$ is equivalent to $W \geq \max[V_I, U_I(\bar{R}_0), U_I(\bar{R}_A)]$, the investor optimally saves his wealth under these parameter constellations.

Note that $\alpha < 0.5$ and $\varphi_5(X) < \varphi_4(X) < \varphi_6(X)$ for all $X \in (\underline{X}, \bar{X})$ because $\alpha < (0.5p_A - p_B)/(1.5p_A - p_B)$. By definition of $\varphi_5(\cdot)$, $U_I(\bar{R}_A) > V_I$ is equivalent to $s < \varphi_5(X)$. Moreover, for $\alpha < 0.5$ one has $U_I(\bar{R}_0) > V_I$ if and only if $s > \varphi_6(X)$.

Consider $\tilde{X}_2$, as defined by (16). Then for $X > \tilde{X}_2$ it is the case that $\varphi_2(X) > \varphi_1(X) > \varphi_6(X)$. As $U_I(R_0) > W \geq V_I$ if $\varphi_1(X) \leq s < \varphi_2(X)$ and $U_I(R_0) > V_I \geq W$ if $\varphi_6(X) < s \leq \varphi_1(X)$, intermediation with $\bar{R}_0$ is profitable if $\varphi_6(X) < s < \varphi_2(X)$. Moreover, as $s > \varphi_6(X) > \varphi_4(X)$, one has $U_I(R_0) > U_I(R_A)$ so that intermediation with $\bar{R}_0$ is optimal.

Direct investment is optimal if $V_I > \max[W, U_I(R_0)]$ and $V_I > U_I(R_A)$. This is equivalent to $s < \min[\varphi_1(X), \varphi_6(X)]$ and $s > \varphi_5(X)$. For $\tilde{X}_1 < X < \tilde{X}_2$ one has $\varphi_5(X) < \varphi_1(X) < \varphi_6(X)$ and for $\tilde{X}_2 < X$ one has $\varphi_5(X) < \varphi_6(X) < \varphi_1(X)$. This proves that direct investment is optimal if $\varphi_5(X) < s < \min[\varphi_1(X), \varphi_6(X)]$.

When $X \leq \tilde{X}_1$, it is the case that $\varphi_1(X) \leq \varphi_3(X) \leq \varphi_5(X)$. Thus $U_I(R_A) > \max[V_I, W]$ for $X \leq \tilde{X}_1$ if and only if $s < \varphi_3(X)$. Moreover, $s < \varphi_3(X) \leq \varphi_5(X) < \varphi_4(X)$ implies $U_I(R_A) > U_I(R_0)$. If $X > \tilde{X}_1$, then $\varphi_5(X) < \varphi_3(X) < \varphi_1(X)$. Thus $U_I(R_A) > \max[V_I, W]$ for $X > \tilde{X}_1$ if and only if $s < \varphi_5(X)$. Moreover, $s < \varphi_5(X) < \varphi_4(X)$ again implies $U_I(R_A) > U_I(R_0)$. This proves that intermediation with $\bar{R}^* = R_A$ is an equilibrium if and only if $s < \min[\varphi_3(X), \varphi_5(X)]$. Q.E.D.

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